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Implications of Taxing Quota Value in an Individual Transferable Quota Fishery

RONALD N. JOHNSON

Department of Agricultural Economics and Economics
Montana State University
Bozeman, MT 59717-0292

Abstract *Taxing pure rents is usually considered the least distortionary method for raising revenues. In the literature on fishery economics, the term "rent" is regularly employed, suggesting that pure rents exist in that sector. Indeed, with the recent development of individual transferable quotas, the resulting market value of quota has been treated as reflecting pure resource rents. In this paper, the view that the market value of quota represents a pure rent that can be readily extracted in a nondistortionary manner by the taxing authority is challenged because that argument ignores both economic incentives and political realities.*

Key words Fisheries taxes, quota value, rent capture.

Introduction

One of the most frequently mentioned regulatory devices in the fishery economics literature is the use of a corrective tax to reduce the amount of fishing effort. Starting with an open access setting, the tax converts a situation of rent dissipation into one of rent capture. Despite its seemingly apparent potential for improving conditions, the use of a corrective tax to regulate a fishery has not fared well in the political arena.[1] Recent development of individual transferable quota (ITQ) fisheries, however, has rekindled interest in the idea of imposing special taxes on that sector.[2] But in contrast to the efficiency-enhancing aspects of a corrective tax under open access conditions, the main objective of taxation under an ITQ system is the transfer of wealth from owners of quota to the government. Moreover, arguments supporting special taxation are predicated on the false notion that the market value of quota represents a pure economic rent that can be readily captured by the taxing authority.

Under an ITQ system, holders of quotas have a legally defined right to catch a specified quantity and type of fish. Although there is only a handful of ITQ fisheries in existence today, that institution is considered one of the best for correcting the problems of overcapitalization and overfishing so prevalent in open access fisheries. When individual fishers have an explicit right to the harvest, they have an enhanced stake in the fishery and are in a better position to benefit from future improvements

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[1] The lack of real world examples of the use of Pigouvian taxes to regulate the fishery, or other forms of externalities for that matter, is well recognized in the literature. See, for example, Scott (1979, p. 735), Johnson and Libecap (1982, p. 1,014), and Clark (1990, p. 255).
[2] For a discussion of the development of ITQ systems in various countries, see the articles in the volume edited by Neher, Arnason, and Mollett (1989). Different methods of taxing rents in an ITQ fishery are discussed in Grafton (1992 and 1995).

in its health. Although fishers themselves have a clear incentive to develop an ITQ system on their own, they have been thwarted in that endeavor by high contracting costs and legal prohibitions against collective action (Johnson and Libecap 1982). Accordingly, the role of implementing an ITQ system has fallen largely to government. The case of New Zealand is illustrative.

On October 1, 1986, New Zealand introduced an ITQ system for most of its fisheries to alleviate problems of overcapitalization and overfishing (Clark, Major, and Mollett 1989). Quotas were allocated on the basis of catch history, followed by a period of quota buybacks and prorated cuts to achieve a sustainable total allowable catch (TAC) and enhance the economic value of the fishery. By most measures, the New Zealand experience would have to be deemed a success. The current market value of quota is close to one billion dollars, which far exceeds the direct costs incurred by the government in establishing the ITQ system.[3] The creation of wealth, however, has attracted the attention of the New Zealand Treasury, who early on viewed the ITQ system as a revenue source:

> Given that ITQs are the leasehold right to harvest the nation's fishery resources, the Crown (as lessor) should charge a resource rental to ITQ holders (lessees) which ultimately appropriates the entire super-profit earned by fishers as a result of being able to harvest the nation's fishing resources, as reflected by the market value of quota.[4]

This statement reflects a misunderstanding about the different sources of economic rents in the fishery. It also conveys the impression that pure rents in the fishery can be readily captured by a resource rental charge. This view is not restricted to the New Zealand Treasury. In their description of the ITQ system, Clark, Major, and Mollett (1989, p. 138) state that "one consequence of the ITQ management system is the generation of economic rent, which can either be taxed away by the government or left in the fishery to be capitalized into the value of the ITQ." Although currently the level of resource rentals are substantially less than the annual lease value of quota, the idea that the government has both the right and ability to extract all of the rents in the fishery has its political supporters.[5]

In this paper, the view that a resource rental charge constitutes a pure wealth transfer is challenged. It is argued that a tax on quota value differs from a theoretically neutral tax on net returns, or an ideally set corrective tax. In particular, a tax on quota value will alter the industry's preferred TAC, shifting it back toward the open access level. The potential for the industry to use the political arena to influence the choice of an allowable harvest is an obvious factor. In New Zealand, for example, the industry has been granted a voice in negotiations with the government over the appropriate TAC. Nevertheless, the ability of the industry to influence the determination of the TAC is ignored in standard models of the fishery. For example, Grafton (1992 and 1995) compares various methods of extracting rents in an ITQ

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[3] The figure was supplied by the Ministry of Agriculture and Fisheries, Wellington, New Zealand. It is based on a survey of quota brokers taken during 1992.

[4] New Zealand Treasury, Treasury Report No. 4498, October, 1985, Appendix 1, p. 2. Although the use of quota values for determining resource rentals has not gone unchallenged (see Linder, Campbell, and Bevin 1992), recent amendments to The New Zealand Fisheries Act of 1983 (F Act of 1983, 107G(7), as amended by s.55(2)(a) FA Act 1990), requires that the market value of ITQs be used in determining resource rentals.

[5] In a media release dated March 2, 1994, the Office of the Minister of Fisheries, Wellington, New Zealand, announced that the term "resource rentals" would no longer be used. The tax has been relabeled an "access fee." In principle, there has been no change, as the fee, if adopted, will be based on quota value. This fee is in addition to charges that will be levied on the industry to recover the government's cost of managing the commercial fishery.

fishery: quota rental charges, a pure profit charge, lump sum charges payable by each vessel, and a royalty charge based on output price. In his analysis, an omnipotent regulator sets the TAC to maximize aggregate rents in the fishery and holds it there as taxes are imposed. But as shown in this paper, imposition of a resource rental charge will cause fishers to lobby for a change in the TAC. In turn, this can affect not only the choice of method of taxation, but it also raises the question as to whether the resource should be subject to any special taxation.

Although the discussion offered in this paper will draw on the experience of New Zealand, it is not intended to be a full description of events in that country. Rather, the New Zealand experience provides a backdrop for discussing the issue of resource rentals in general. The first section of this paper commences with a brief discussion of economic rents in a natural resource setting. It is then demonstrated that when factor rents besides those associated with the fishery resource exist, resource rentals can impact optimal stock levels and harvest rates. In the second section of this paper, the impact of resource rentals on enforcement costs, incentives for collective behavior, and inventive activity are discussed.

Economic Rents, Resource Rentals, and Optimal Stock Levels

Economic Rents

Economic rent is commonly regarded as a payment to the owner of a resource where the availability of the resource is insensitive to the payment received.[6] In the standard supply and demand diagram, the supply curve would be a vertical line, invariant to price. Should a tax be imposed on the market value of the resource, supply would be unaffected, suggesting that taxation causes no deadweight loss. The concept of optimal taxation emphasizes the efficiency aspects of various taxes.[7] Within that framework, a sector of the economy thought to contain economic rents would be more heavily taxed.

The term "rent" is regularly employed in the literature on natural resource economics. In models of optimal resource use, the objective of the resource manager frequently is maximization of rents. Yet few natural resources conform to the common definition of rent given in the opening sentence of this section. David Ricardo (1821, p. 33), for example, referred to rent as the payment for the "uses of the original and indestructible powers of the soil." In retrospect, it seems strange to refer to soil as indestructible. It can be depleted or overused, depending upon the incentives facing the user. Once it is recognized that the supply of a natural resource is not an indestructible flow, it no longer follows that a system of optimal taxation implies higher taxes on the natural resource sector.[8] Indeed, the timing of extraction or method of harvesting a natural resource may be highly sensitive to taxation.[9]

Moreover, there are factors of production other than natural resources where the supply function is not perfectly elastic. An example of such a factor could be special

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[6] The concepts of economic rent used in this paper are based on those described by Alchian (1987).

[7] An enormous amount of information on actual tax incidence is required to make the concept of an optimal tax system operational. Despite the obvious lack of this information, it is nonetheless a popular concept among tax policy debaters. See the discussion of optimal tax systems by Slemrod (1990).

[8] Diamond and Mirrless (1971) and others have shown that in the absence of pure rents in the economy, production efficiency requires that there be no differential factor taxes, or even taxes on intermediate goods for that matter.

[9] There is also a well-developed literature that examines the impact of taxes on extraction rates and time paths of both renewable and nonrenewable resources. With the exception of some ideally set tax on net returns, deviations in resource use will result. For a survey of the literature showing how taxes can alter extraction profiles and harvest rates, see Heaps and Helliwell (1985).

managerial talent that is important only to the particular industry under scrutiny. Assuming this heterogeneity occurs naturally, and it is too costly to reproduce its special distinguishing features, the long run supply function for that factor will be upward sloping. Accordingly, payment to the inframarginal units will exceed their opportunity cost. For the purposes of this paper, this net return to a factor of production will be referred to as a rent.[10]

The Impact of Resource Rentals

Now consider the traditional model of the fishery. There, it is commonly asserted that under open access conditions, entry will occur to the point where economic rents are zero.[11] Supposedly, this problem can be corrected and rents maximized by restricting entry, either by issuing explicit property rights or through regulations. As mentioned in the opening remarks, one form of regulation that is frequently discussed in the literature is the use of a corrective tax to reduce the amount of fishing effort. Fishing effort is usually denoted as a function of the capital and labor inputs used to harvest fish. The objective of corrective taxation is to reduce the amount of redundant effort and allow the fish population time to recover. If the tax rate is set correctly, either on fishing effort or on the harvest itself, the implicit rental value of the fishery resource will be maximized.[12] The tax can achieve this objective, in part, because it alters the equilibrium stock level of the fish population. The important point here is that the imposition of the tax actually generates the very rent that is subsequently collected by the taxing authority. Under a system of corrective taxation, property rights—either in the form of limited entry or ITQs—usually are assumed not to have been established. Hence, under this scenario, the government or taxing authority is the implicit owner of the resource. On the surface, this would appear to be an attractive outcome—at least if economic efficiency is the criterion. In the classic example, taxation causes no deadweight loss as there is actually a net gain to the economy in the form of tax revenues. Indeed, if the fishery had other significant value, such as in contributing to the genetic pool, the tax could have additional benefits by reducing the probability of extinction.

But corrective taxes have not been the regulatory instrument of choice. One obvious reason is that taxation does not benefit fishers, and they have political clout in lobbying against taxation. Within the context of the standard fishery model, the tax will induce the exit of boats and crews from the fishery. If these factors were highly mobile, the adjustment process would be relatively smooth. However, boats and crews are often highly specialized, and the tax will bite into quasi-rents. But specialization is not restricted to the short run. In contrast to the implications of the standard model, rents can be positive in the fishery even under open access conditions.

Individuals engaged in the fishery often talk about skippers, vessels, and crews whose performance is exceptional year after year.[13] Some of the observed differ-

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[10] As Alchian (1987, p. 142) points out, these net returns are often referred to as "Ricardian Rents." In addition, Alchian explains that there are also "differential rents" which reflect "premia to units that are the same value here but different in their best use values." Regardless, the factor supply function, or Alchian's RR function, will be upward sloping, implying the existence of factor rents.

[11] See, for example, Hartwick and Olewiler (1986, pp. 243–68); Tietenberg (1992, p. 313); and Kahn (1995, p. 277). If pressed, I suspect most of these authors would agree that inframarginal rents exist. Nevertheless, it is this simple model of complete rent dissipation under open access conditions that the taxing authorities seem to have in mind.

[12] A tax on landings would most likely be less costly to administer than a tax on effort.

[13] The existence of crews who are substantially more productive than others even when using similar equipment is often noted in the literature. See, for example, Scott (1979, p. 733). For empirical support, see Johnson and Libecap (1982) and Finnell (1995).

ences can be attributed to innate skills that are not readily transferable to other industries (Johnson and Libecap 1982). The potential for rents in the fishing industry, however, extends beyond the harvesting sector. Special managerial talent in the processing sector also is a potential source of rents that depend on the existence of the fishery. Heterogeneity in skills or talent implies that the long run supply curve for factor inputs, including those associated with the processing sector, is upward sloping. A tax or royalty on the harvest will not only have a negative impact on quasi-rents, but can reduce the returns to special talent. Thus opposition to taxation can persist even in the long run.

Now, instead of a corrective tax, consider the assignment of ITQs. The purpose of the ITQ is to limit entry and increase the rents generated in the fishery. Of course, allocating ITQs is the same as distributing wealth, so disagreement and conflict can be expected. But once the assignment process has been completed, the ITQs provide a means for managing the fishery. If those engaged in the fishery were to maximize aggregate net returns under the ITQ system, the optimal harvest rate would seemingly be the same as that selected under the corrective tax scheme. Given that the two systems for regulating a fishery yield the same outcome, at least theoretically, it is tempting to conclude that the taxing authority could proceed to tax away the market value of quota without altering resource use. If correct, a tax on quota value would be neutral, causing no distortions in the primary market.

To better analyze the conditions wherein a tax on quota value may or may not be neutral, a dynamic, but fairly standard, model of the fishery will be used.[14] The biological aspects of the fishery can be captured by the ordinary differential equation

$$\frac{dx}{dt} = F(x) - h(t). \tag{1}$$

Here, $x = x(t)$ is the size of the fish population at time t and $F(x)$ is a function representing the natural growth rate of the fish population. The function, $F(x)$, is assumed to be twice differentiable with a maximum value, commonly referred to as the maximum sustainable yield.[15] The harvest is denoted $h(t)$ and is assumed to be a function of a catchability factor, $q(x)$, and fishing effort, denoted E,

$$h = q(x)E. \tag{2}$$

Since catchability is enhanced when the stock is large, the first and second partial derivatives of $q(x)$ are assumed positive and negative, respectively,

$$q'(x) > 0, \text{ and } q''(x) < 0. \tag{3}$$

Here, effort is a composite measure, a function of labor and capital inputs used in harvesting and processing fish. Following convention, the inputs are expressed in constant quality units and the exponent of E has been set equal to unity, implying that effort is produced under constant returns to scale. Thus, if there are rents associated with any of the inputs subsumed in the effort function, they will be reflected via factor price effects.

In New Zealand, the fishery is relatively small compared to the world market, so that the price of processed fish, P, can be taken as a parameter. Denote the opportunity cost of effort as $C(E)$, where C' is the marginal cost of effort. Accordingly, C' traces the supply curve for effort, and the area underneath the C' function measures

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[14] For a full description of this model and variants of it, see Clark (1990).

[15] The intent here is that the function, $F(x)$, reflect the standard Schaefer model. See Clark (1990, p. 15).

the opportunity cost of effort. Note that if C'' is positive, there will be an explicit factor price effect, implying that rents are positive even under open access conditions.

Now, assume that the ITQ system is already in existence, and allow the harvesters, processors, and quota owners to be one and the same. This is consistent with the situation in New Zealand, where much of the industry is vertically integrated.[16] Accordingly, assume that their collective objective is the maximization of aggregate rents, which include the value of quota. Here, the quota represents a right to a share of the total harvest. This arrangement is similar to one that currently prevails in New Zealand. Since 1990, an ITQ has represented a tonnage-denominated entitlement that varies with changes in the TAC. The key institutional ingredient in this model that differs from standard assumptions is that the TAC is assumed to be determined collectively by the industry, not the taxing authority. In New Zealand, the TAC is determined annually by the Minister of Fisheries in consultation with industry representatives.[17] Absent taxes on quota value, and assuming that the industry has sufficient political influence in the TAC determination process, the current-value Hamiltonian for this problem is

$$H = Pq(x)E - C(E) + u\left[F(x) - q(x)E\right]. \tag{4}$$

Given the above assumptions, the Hamiltonian is strictly concave. The maximum and adjoint equations are

$$H_E = Pq(x) - C' - uq(x) = 0 \tag{5}$$

and

$$H_x = Pq'E + uF' - uq'E = ru - \dot{u}. \tag{6}$$

In this constrained optimization problem, the costate or adjoint variable, u, measures the marginal value of the fish stock. Under an ITQ system, u would, in this particular case, also measure the per unit value of quota, the periodic or lease value of quota. Rewriting equation (5) reveals that the output price minus the marginal cost of harvesting fish, $C'/q(x)$, equals the marginal value of the fish stock, u.[18]

$$P - \frac{C'}{q(x)} = u. \tag{7}$$

In equation (6), r is the rate of interest and $\dot{u}$ is the time derivative, du/dt. The focus of analysis will be on the steady state solution; thus, $\dot{u}$ is set equal to zero. Rearranging terms yields

$$F' = r + q'E - \frac{Pq'E}{u}. \tag{8}$$

[16] In 1993, the quota holdings of the top four firms in the industry accounted for about 42% of total quota holdings, while the top thirty firms had approximately 82% (New Zealand Fishing Industry Board, 1993, Appendix 4). These firms are engaged in both harvesting and processing of fish.

[17] New Zealand Fisheries Act of 1983, F Act 1983, section 13.

[18] Since the production function is $h(t) = q(x)E$, the marginal product of effort is simply $q(x)$. Marginal factor cost is equal to C'. It follows from the basic theory of the firm that dividing the marginal factor cost by that factor's marginal product yields the cost of producing an additional unit of the output (Hirshleifer and Glazer 1992, p. 288).

Or, substituting for u using equation (7),

$$F' = r - \frac{\dfrac{q'C'E}{q(x)}}{P - \dfrac{C'}{q(x)}}. \tag{9}$$

Since F' is the slope, dF/dx, of the natural growth function, an increase in F' implies a reduction in the stock of fish. Accordingly, if the rate of interest were to increase, F' would increase, implying a reduction in the steady state stock level. However, reductions in the level of stock also increase the marginal cost of harvesting. Since the sign of the second term in equation (9) is negative, F' could be positive, negative, or zero. That is, the optimal rate of harvest could require that the corresponding optimal stock level be greater than, less than, or equal to the level that would maximize sustainable yield. Selecting the optimal harvest rate implies making a trade-off between the gross returns to harvesting and a reduction in harvesting costs. Once the optimal harvest rate is selected, the quota right will become an explicit harvest right. In the absence of any tax on quota value, and given competition and transferability, the market or lease value of a quota right will equal the marginal value of the resource stock, u in equation (7). In equilibrium, all fishers will have the same marginal cost of harvesting, and each will value the right to harvest an additional quantity of fish at u.

Now consider the imposition of a tax of t, $0 < t \leq 1$, on the aggregate rents associated with the fishery. The Hamiltonian for this problem is

$$H = (1 - t)[Pq(x)E - C(E)] + u[F(x) - q(x)E]. \tag{10}$$

The maximum and adjoint equations are

$$H_E = (1 - t)[Pq(x) - C'] - uq(x) = 0 \tag{11}$$

and

$$H_x = (1 - t)Pq'E + uF' - uq'E = ru - \dot{u}. \tag{12}$$

As was done above, equations (11) and (12) can be used to solve for F'. Once that is done, it is a straightforward exercise to show that the same result reported in equation (9) will be obtained. That is, the term $(1 - t)$ will cancel out, implying that the imposition of this type of tax will not affect the choice of the optimal harvest rate. This result demonstrates the standard policy recommendation so prevalent in the literature on natural resources: tax net returns so as not to distort extraction profiles.[19] But to effectively tax in this nondistortionary manner requires that the taxing authority know both the output price and marginal cost of production. While information on price is likely obtainable, it is unlikely they would have sufficient information on the cost of harvesting. Once an ITQ system is implemented, however, the taxing authority may obtain information on the market value of quota.[20] Moreover, it is con-

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[19] See, for example, Heaps and Helliwell (1985, pp. 428).

[20] The information content of quota prices and how they can aid fishery managers is discussed by Arnason (1989). However, an explicit assumption in Arnason's paper is that the total value of ITQs reflects all of the rents in the fishery. That is, the long run supply schedule for effort is assumed horizontal. Hence, fishery managers seeking to maximize the net benefits of the fishery have a market determined measure, quota value, to aim for. The importance of that assumption is demonstrated in the text.

ceivable that the taxing authority would view the lease value of quota as a correct measure of rents being earned in the fishing industry. Indeed, as noted in the introduction to this paper, the New Zealand Treasury appears to adhere to that view. But if taxed on the basis of the lease value of quota, fishers will have an incentive to alter their behavior and, in doing so, alter the market value of quota.

As before, it will be assumed that there is a competitive and active lease market for quota, with some quota owners electing to lease part or all of their quota. The lease market provides the data used by the tax authority to value quota. To further simplify, assume that the tax or resource rental is imposed on the owner of quota, not the lessee.[21] Given this tax incidence, the maximum value a lessee will place on the right to harvest an additional unit is the difference between the output price and marginal cost, $p - C'/q(x)$. Assuming competition in the quota market, this will be the observable lease price. Accordingly, quota owners will pay $t[p - C'/q(x)]$ to the taxing authority and net $(1 - t)[p - C'/q(x)]$. The total lease value of all quota is simply $[p - C'/q(x)]$ multiplied by the total harvest, $q(x)E$. When a tax of t is imposed on the lease value of quota, the corresponding Hamiltonian is

$$H = Pq(x)E - C(E) - t\left(P - \frac{C'}{q}\right)q(x)E + u\left[F(x) - q(x)E\right]. \tag{13}$$

The maximum equation is

$$H_E = (1 - t)\left[Pq(x) - C'\right] + tC''E - uq(x) = 0. \tag{14}$$

Inspection of the above equation reveals that u no longer equals the lease value of quota, $p - C'/q(x)$, when the lease value is taxed. As t increases, u declines, indicating that the implicit value of the stock has declined. This decline will induce the industry to lower the steady state stock level. The adjunct equation is

$$H_x = (1 - t)Pq'E + uF' - uq'E = ru - \dot{u}. \tag{15}$$

Using equations (14) and (15) and solving for F' yields

$$F' = r + q'E - \frac{Pq'E}{P - \dfrac{C'}{q(x)} + \dfrac{t}{(1 - t)}\dfrac{C''E}{q(x)}}. \tag{16}$$

A comparison of equation (16) with equation (9) reveals that a tax on the lease value of quota can have a different impact on resource use than a tax on net returns.[22] In equation (16), allow the tax rate to approach unity. As t approaches unity, the denominator of the third term in equation (16) approaches infinity, leaving the first two terms of the equation to determine F'. Both of those terms are positive, implying that the fishing industry will desire a reduction in the stock level compared to the no-tax scenario. Although a tax on quota value reduces the net returns to the

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[21] This is a simplifying assumption, as the tax could be placed on the lessee with the same qualitative results.

[22] This result contrasts with Grafton's (1992, p. 502) claim that "it is notable that both a quota and a profit tax can capture the total rent in the fishery at the long-run equilibrium." In a later paper, Grafton (1995, p. 58) acknowledges that a pure profit tax would be relatively costly to implement.

fishing industry, the key to understanding the incentives facing the industry is the existence of a factor price effect, $C'' > 0$. If C'' were equal to zero, equation (16) would be identical to equation (9), and a tax on quota value would be equivalent to a tax on net returns. When C'' is positive, however, the supply curve for effort is upward sloping, and rents in addition to those captured by quota value are being earned. When the returns to quota ownership are confiscated by the tax, there is an incentive to shift the relative use of stock and effort in such a way that the net returns to effort increase. Because rents are earned on factors of production other than the stock, the tax induces the industry to emphasize those other factors of production. Indeed, the industry may actually lobby for a return to open access conditions. The outcome will depend, in part, on whether the initial stock level was to the right or left of the maximum sustainable yield level. Nevertheless, these results show that the taxation of quota value does not yield a neutral outcome when there are other factors of production whose supply to the industry is not perfectly elastic. Of course, in deriving this result it is asserted that the industry is capable of influencing the determination of the TAC.

There are different political systems in this world, but if the analysis is restricted to representative democracies, elected officials should be acknowledged as key players. While the motives of elected officials may vary and are not always conspicuous, they most commonly seek reelection. That entails tending to constituent interests and overseeing the behavior of regulatory agencies. Although the notion that regulatory agencies are "captured" by the industry they are supposed to regulate is extreme, elected officials are clearly cognizant of constituent groups who can either help or harm their chances for reelection.[23] To better serve their constituents, elected officials will commonly seek membership on committees most closely aligned with the welfare of their constituents (Fiorina 1989). Membership on these committees allows elected officials a direct say in the design of regulatory policy. While the day-to-day operation of the agency is often left to bureaucrats, the electoral process assures that the groups most affected will have a say in how the agency operates.[24]

Compared to the limited scope and narrowly defined constituency of most regulatory agencies, national treasury departments are more closely identified with the broader constituency and policy issues of the chief executive: the president or prime minister. While not absent from the pressures of parochial interests, treasury departments are relatively immune from them, at least in a direct sense. Given their mandate, they may seek to raise revenues in what they perceive to be the least costly way. In response, elected officials can be expected to rally around their affected constituencies. Even if these representatives fail to ward off a tax increase, they likely will be sympathetic to efforts by their constituency to reduce its impact. This behavior underlies the result shown in equation (16). The tax on quota, imposed by one agency, alters the preferred stock level as seen by the industry, who in turn lobbies the agency controlling the TAC to make adjustments.

There is another point worth noting. If the government has the knowledge to set

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[23] When aiding a constituency, elected officials will seldom act as perfect brokers. Instead, they trade off the support of the various competing groups. See Peltzman (1976).

[24] In much of the fisheries literature, the agency in charge of managing the fishery is treated like a black box. It is devoid of checks and balances, but for some unspecified reason has the clear objective of maximizing net social returns. That approach ignores the electoral process and constituent interest. It also ignores the desire bureaucrats have to satisfy their own objectives, and these can differ from those of elected officials. Indeed, they may be even more sympathetic to the plight of the industry than elected officials if they view the industry as a potential future employer. The amount of leeway they have to act in a discretionary manner will vary across governmental forms, but they are often in a position to influence outcomes. Reasons why bureaucrats have been allowed discretionary power are discussed in Johnson and Libecap (1994).

the optimal TAC and the political muscle to extract substantial rents in the fishery, then it is hard to see why an ITQ system would be their regulatory choice. Armed with both knowledge and mission, the government seemingly would be in a position to adopt and implement an optimal tax. In practice, however, precise data on most fish populations are seldom available, and the industry itself must be relied upon to provide information on effort as well as figures on the harvest. Absent cost data, the government may resort to experimenting with different TACs to maximize tax revenues. But as shown in the above model of the fishery, as long as other sources of rents exist, maximizing tax revenues will not maximize aggregate rents. By going through the process of establishing an ITQ system, the government has demonstrated that either it does not have the political will to impose an optimal corrective tax, or it lacks the information to do so. Although it is likely that both factors pertain, it should be clear that taxing the market value of quota can destroy information needed by the government, as the industry will find ways to adjust stock levels and hence, quota values. As a consequence, a tax on quota value should not be considered a neutral tax.

Given the above results, it is no doubt tempting to think of other forms of taxation that would yield a neutral outcome. Taxes based on the value of landed fish are often advocated as a method for regulating an open-access fishery. But if imposed on an existing ITQ fishery where quota holders have a say in determining the TAC, the landings tax will be nonneutral. Again, consider equation (9). Imposing a landings tax amounts to reducing P. But a reduction in P will induce the quota holders to act collectively to alter harvest levels. Of course, there remains the prospect of imposing a lump sum tax on each vessel in the fishery, or some other factor. But if that factor is alterable, as is the number of vessels, a lump sum tax will cause a distortion because there will be an incentive to reduce use of the factor that is being taxed. Such fees will be discussed further in the concluding remarks.[25] In the following section, additional reasons for the nonneutrality of resource rentals are given.

Enforcement, Investment, and Collective Action

A nagging problem for any fishery management system is enforcement. Under an ITQ system, cheating can occur in a variety of ways. Fishers may fail to report their harvest, or misreport its weight. When a report is filed, they may attempt to report the species taken as some other species with a lower quota value. Or the catch may be reported as having been made in a legal fishing area when, in fact, it was obtained elsewhere. Another persistent problem for the regulator is by-catch. In a multispecies fishery, species other than those being legitimately targeted will occasionally be caught. Knowing when this by-catch, harvested in excess of quota, was taken incidentally in the process of catching the targeted species is difficult. Although fishers under an ITQ system have an incentive to engage in self policing, the large numbers of fishers and the difficulty of detecting poachers leaves the system vulnerable (Scott 1989, p. 29). Since it is very costly to monitor most fishing activity, the probability of detecting violators is substantially less than unity. In this environment, heavy fines and penalties can deter cheating (Sutinen and Andersen 1985).

Under New Zealand law, not only are fines imposed upon conviction of quota management offenses, but the law explicitly calls for the forfeiture of quota except in extenuating circumstances.[26] The value of quota forfeited can readily exceed the amount collected in fines and loss of equipment, which also may be confiscated. If

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[25] Auctioning off the rights to the fishery is also a frequently mentioned alternative. But like the corrective tax scheme, it too faces high political costs.

[26] Fisheries Act of 1983 as amended, FA 107B.

the government elected to tax quota value, the possibility of forfeiting quota could lose much of its deterrent effect, forcing the government to place more reliance on fines. Since in the absence of an ITQ system most fishers are not noted for their wealth, fines would not be a perfect substitute for forfeiture of quota. If the problems of enforcement become substantial, stock levels could once again be affected.

Resource rentals can also have a negative impact on the incentives facing members of the industry to invest in cost-reducing activities. A decrease in the cost of effort shifts the supply function to the right, thus increasing the rental value of the fishery. If the market value of quota is being fully taxed away, however, the reduction in harvesting costs may not benefit fishers. What matters is how the cost function shifts. If there were no resource rentals, a reduction in costs would unambiguously increase the industry's aggregate returns to inventive activity.

There are certainly exceptions to the above implication. Where patents can be perfected, the returns to inventive activity will largely be reflected in the price of the cost-reducing device rather than in the value of quota. In that case, the supply function for effort may not shift, or shift less than it would if the right to use the device were made freely available. Even in the absence of patents, returns to inventive activity can be positive. Since fishers are heterogeneous, those who are quick to adopt the device can earn inframarginal returns in the short run, and these returns may be sufficient to attract resources into the processes of discovery and development. But in the absence of resource rentals, the ITQ system offers a rather unique way of capturing returns to inventive activity.

Although on balance the patent system encourages inventive activity, it is far from a perfect protector of ideas (Cheung 1982). Consider a fisher who invests time and other resources to uncover new methods for harvesting fish. Even if the end result is patentable, costly litigation may be required to prevent others from imitating it. Moreover, to capture returns under the patent system, use of the cost-reducing idea is restricted (Arrow 1962). In contrast, if the fisher owns or can purchase quota, positive returns to discovery are available through the appreciation of quota value as the idea proliferates and finds it way into common usage.[27] As a consequence, there is a potential efficiency consideration that favors the use of appreciation in quota value compared to the patent system. If returns come in the form of quota appreciation, widespread usage is beneficial to the innovator and the industry. Additionally, in the absence of resource rentals, the ITQ system provides incentives for the industry to act collectively to lower costs and engage in activities such as product development and fishery management that have the potential to increase quota value.

One of the great promises of the ITQ system is its potential for galvanizing collective action. By restricting entry, the ITQ system eliminates at least one important obstacle to contracting. Because the identities of the participants are known, organizational costs are lower than in an open access setting. Bargaining is also facilitated because quota owners have a value in common, namely quota value. Unlike agricultural land, where most of the decisions of the landowner can be thought of as being internalized, fishers rely on the same common fish stock. Hence, even under an ITQ system, margins for the dissipation of rents remain. For example, since the fish stock enters the cost function of each fisher, there is an incentive to harvest early in the season when stocks are higher. Because spillover effects remain, there is a need for collective action when undertaking fishery management and enhancement programs. Since the introduction of an ITQ system in New Zealand, associations of

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[27] The potential for ITQs to act as an inducement to inventive activity is also noted by Anderson (1989, p. 204) and Grafton (1992, p. 501).

quota holders have begun to develop. These associations have sought and obtained agreements to restrict harvests, spread the catch out over time, and redefine management areas in a more operational manner so that investments can be undertaken.[28] The substantial increase in resource rentals that some in the government are requesting threatens these associations, as the increase would reduce the incentives of fishers to engage in collective action.

Concluding Remarks

Throughout much of the world, privatization is being touted as a means to raise living standards. But governments also appear to view these newly-formed entities as part of an enlarged tax base. Privatization of the fishery, for example, has fostered the argument that the value of quota can and should be taxed away by the government. This policy has been predicated on the grounds that the government owns the resource and is entitled to the rents generated by the fishery, and that resource rentals merely capture pure rents. The arguments presented in this paper challenge the notion that taxing rents in an ITQ fishery amounts to a pure transfer, devoid of deadweight losses. Closer examination reveals numerous margins for adjustment to resource rentals. Although the issue of whether the government does in fact own the fishery is not addressed in this paper, it is not clear the government has the ability to maximize aggregate rents. As a consequence, tax revenues may actually be higher if resource rentals are not imposed.

Under an ITQ system, and in the absence of resource rentals, the fishing industry has an incentive to maximize aggregate rents, not just the value of quota. The greater these rents, the higher are revenues from taxes on firms' profits and individuals' incomes. These revenues can exceed the returns from resource rentals. As argued in this paper, imposition of resource rentals will cause the industry to seek harvest rates that do not maximize aggregate rents in the fishery, thus lowering the tax base. Moreover, even if the resource rental is not set to extract the total lease value of quota, the government will still be in a position similar to that of a landlord under a share tenant arrangement. Since the industry will have less incentive to develop the fishery, the government will be in a quandary, having to decide where and how to invest in the fishery in order to increase net rents. Although the government may claim ownership of the resource, the task of harvesting under an ITQ system is left to others whose behavior should not be assumed to remain unchanged by resource rentals.

While the arguments presented in this paper are intended to illustrate the adverse effects of resource rentals, it should not be inferred that the fishing industry ought to be exempt from special levies. Experience has revealed that an ITQ system can be costly to the government, both in terms of implementing the initial property rights, and in enforcing those rights once they are established. User fees aimed at recovering the government's legitimate costs of defining and policing an ITQ system not only seem equitable, but the fees would serve as a check on whether the system is worth maintaining. In order to provide a check of the benefits and costs of an ITQ, the fees, unlike resource rentals, should not be linked to quota values. Instead, lump sum fees should be charged to quota owners based on the percentage or share of the TAC they hold.

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[28] For example, in 1993, fishers holding orange roughy quota in one of the fishery management areas established their own company to help monitor and enforce collectively agreed upon restrictions. Access to certain areas was limited and the timing of harvest was spread out.

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